Visual Perception
OpenCV Toolbox
User Manual

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1 Introduction

Developing Computer Vision applications can be tough. One should consider the capabilities of the framework, on the other hand how this framework will react and perform on given test data. In other case, one may want to see only effect of the consecutive image processing functions on test data. In both and many cases, small toolboxes of the frameworks help people to see results easily, fast and enable them to fast prototyping. Hence this toolbox is created for Computer Vision application developers and enthusiast who want to see image processing functions on their images with very basic knowledge. It's developed with minimal design, which makes it easy to use. However it is also powerful toolbox due to its support of parameters.

2 Getting Started

2.1 Basics

This application is embedding functions of OpenCV(tested on 2.4.8) for users. This application consist of one main window and sub-windows prompt upon on displaying input and output images by OpenCV. It accepts one image at a time and storing it as original image. Each modification is applied on output image consecutively. There is also history option keep track of change of the output image where you can revert to any old state you want. By default, all operations are disabled until you select an image.

2.2 User Interface

User interface consist of 4 buttons and a tab view which embeds all image processing functions.
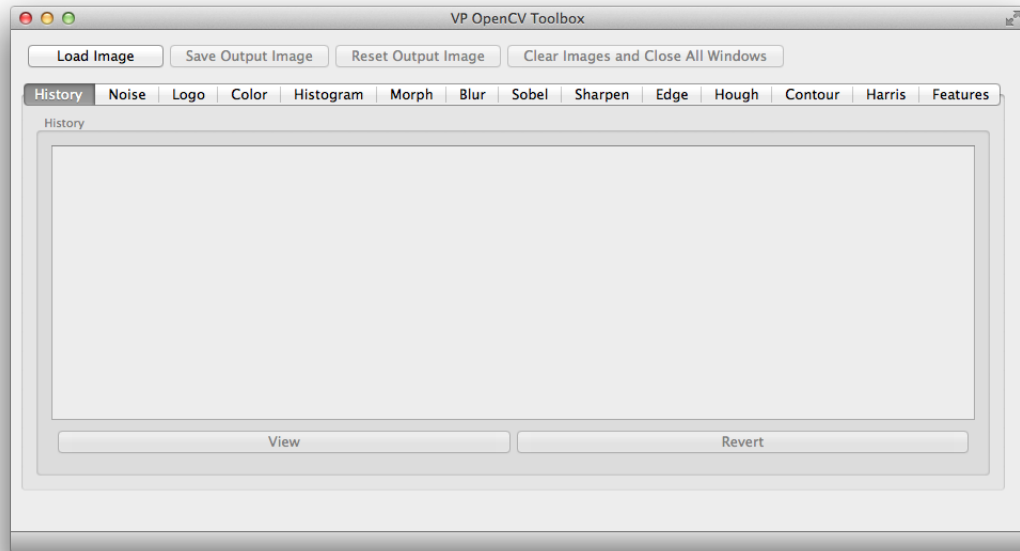
Figure 1: VP OpenCV Toolbox

Main buttons:

- Load Image: Loads image.

- Save Output Image: Saves current output image.

- Reset Output Image: Resets output to original loaded image.

- Clear Images and Close All WIndows: Clear history stack, output and closes windows.

Tabs:

- History: History of change of output images

- Noise: Adding salt and pepper noise

- Logo: Adding logo and ROI

- Color: Changing color space

- Histogram: Calculating and Equalizing Histogram.

- Morph: Morphological Operations.

- Blur: Blurring operations.

- Sobel: Sobel and Laplacian derivative operators.

- Sharpen: Sharpening images.

- Edge: Canny Edge Detect.

- Hough: Hough Transfor finding lines and circles

- Contour: Finding countours of connected objects.

- Harris: Harris corner extraction.

- Features: Extracting FAST, SURF, SIFT key points.

3   Image Input and Output

Image input and output is very easy in this toolbox. "Load Image" button in upper left corner opens file dialog and enable to select any image in your computer. Supported formats are *.png, *.jpg, *.jpeg, amd *.bmp; by default, OpenCV loads images in BGR color space. As soon as you select and load image, image is opened in windows titled "Input", which you can see there is already toolboxes on it which enable you to zoom in/out, showing pixel values and even saving.

Even Qt built OpenCV windows has saving option, there is also saving current image option on left top of application. It opens save dialog and let you save your image any place you want.

4   Image History

Image history is one of the strong functionality of this toolbox. After your each operation, output image is saved and kept for history.

In any moment, you can go history tab and click "Revert" button to go back to that state of the image. Another beautiful feature is you can see that history items by clicking "View" and they will be pop-up in seperate windows, you can open as much as you want.
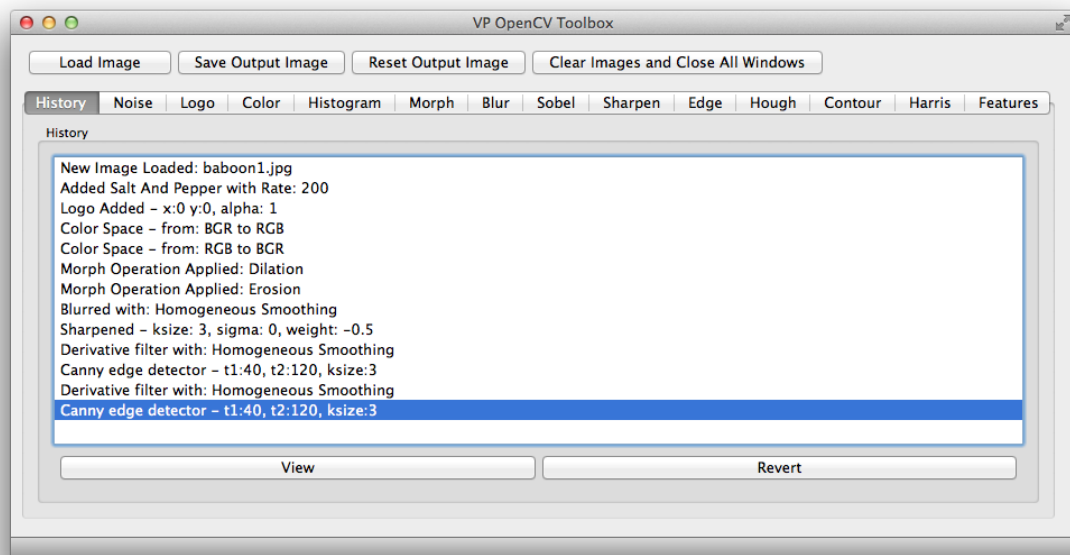

Figure 2: History with Details

5 Noise

In "Noise" tab, there is only Salt and Pepper noise option. It's adding white and black pixels to your image with given amount as "Rate" parameter, by default set to 100. Salt and Pepper options are with check-boxes, you have option to add them separately.
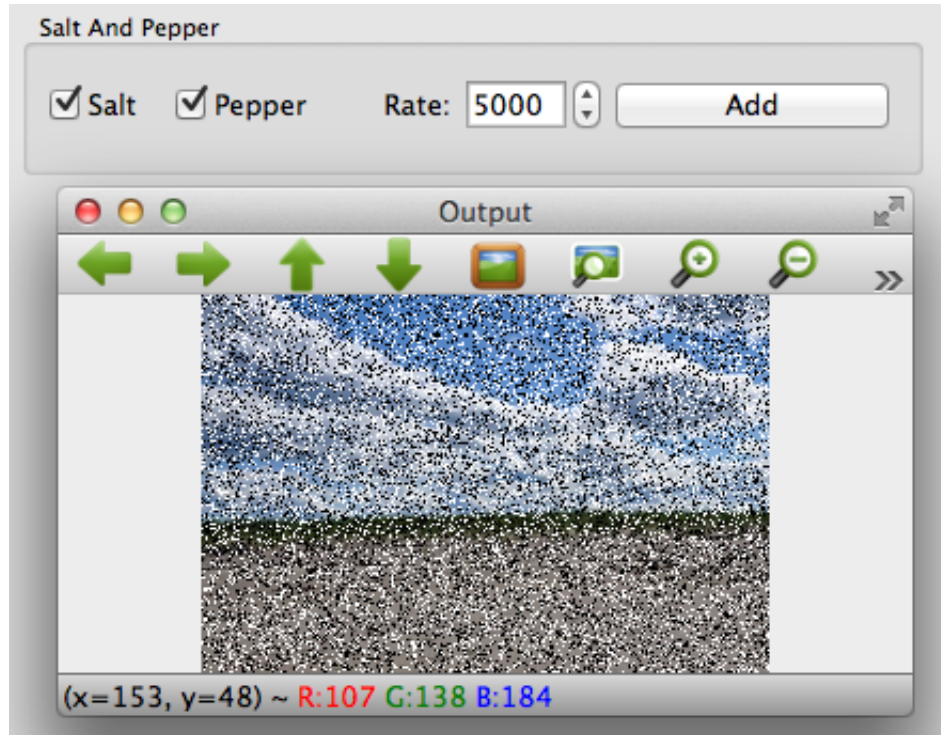

Figure 3: Salt and Pepper Noise

6 Logo

In "Logo" tab, first you need to load logo by clicking "Load Logo". You should select logo smaller or equal to output image size, otherwise warning message will appear. Click "Add Logo" to add your logo. There are 5 parameters you can manipulate before adding logo to your image. Here are the parameters:

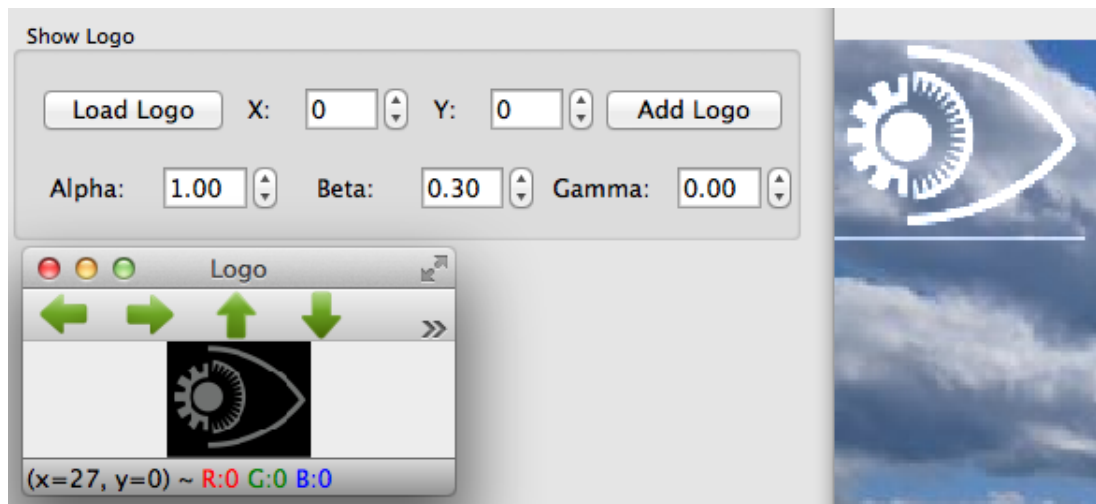| Parameters	Details
X	Logo offset X
Y	Logo offset Y
Alpha	Weight of the image
Beta	Weight of the logo
Gamma	Scalar added to each pixel

Figure 4: Adding Logo

7 Color

In "Color" tab, you can change the color space of the your current image. Supported color spaces are: BGR, RGB, GRAY, HSV, HLS. Current color space combo-box is disabled by default that showing current color space of the image. Each time you change the color space both 'Current Color Space' and 'New Color Space' combo-boxes are updated accordingly.
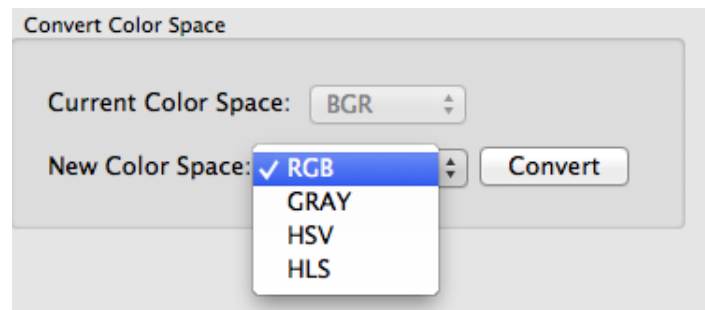

Figure 5: Changing Color Space

8 Histogram

In "Histogram" tab, you can calculate histogram of the image or equalize histogram of the current image. There is also option to choose channel for viewing histograms for multi channel images.
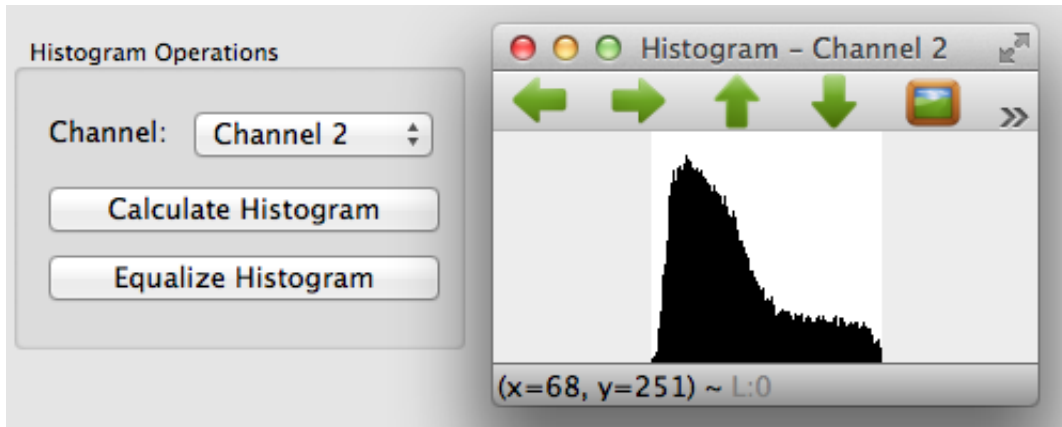
Figure 6: Histogram Calculation

9 Morph

In "Morph" tab, you can perform morphological operations to your current image. Available operations are; Dilation, Erosion, Opening, Closing, Morphological Gradient, Top Hat and Black Hat. Parameters are:

| Parameters	Details
Operation	Dilation/Erosion/Opening/Closing/Morphological Gradient/Top Hat/Black Hat
Iteration Count	Number of times erosion and dilation are applied
Kernel Size	Size of the structuring element.
Kernel Type	Element shape
Kernel Anchor X	x-coordinate of the kernel anchor
Kernel Anchor Y	y-coordinate of the kernel anchor
Image Padding Method	Pixel extrapolation method
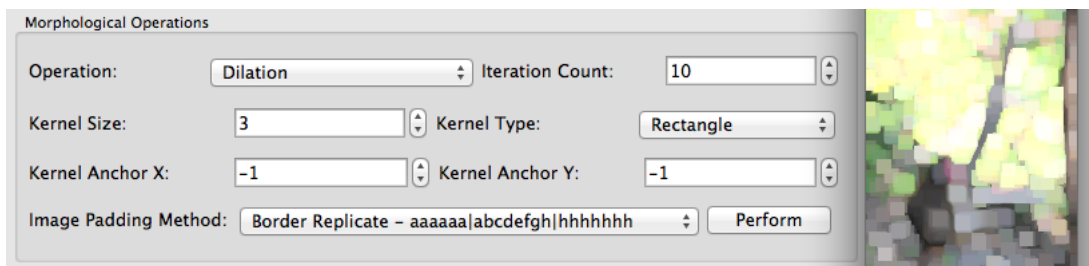
Figure 7: Histogram Calculation

10 Blur

In "Blur" tab, you can perform blurring your image with Homogeneous, Gaussian, Median or Bilateral smoothing.You also have options to specify kernel size, its anchor and border replication method. Parameters are:

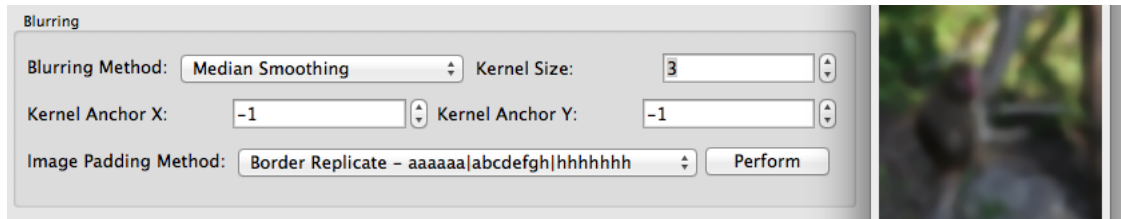| Parameters	Details
Bllurring Method	Homogeneous/Gaussian/Median/Bilateral
Kernel Size	Size of the structuring element.
Kernel Anchor X	x-coordinate of the kernel anchor
Kernel Anchor Y	y-coordinate of the kernel anchor
Image Padding Method	Pixel extrapolation method

Figure 8: Blurring

11 Sobel

In "Sobel" tab, you can use Sobel and Laplacian operators with many parameters. Parameters are;

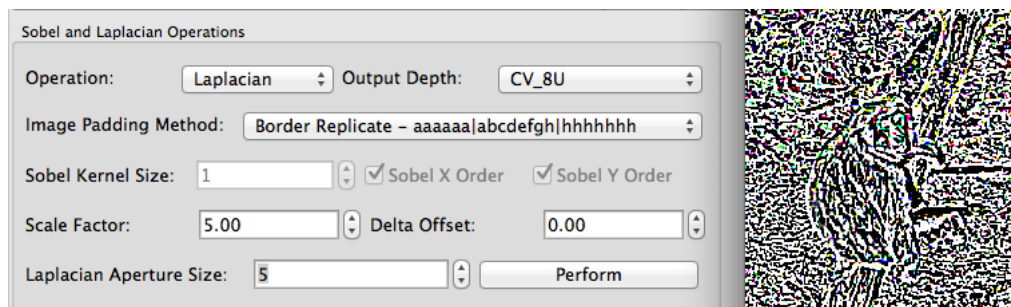|	Details
Operation	Sobel/Laplacian
Output Depth	CV_8U/CV_16U/CV_16S/CV_32F/CV_64F
Image Padding Method	Pixel extrapolation method.
Sobel Kernel Size	size of the extended Sobel kernel; it must be 1, 3, 5, or 7
Sobel X Order	Order of the derivative x
Sobel Y Order	Order of the derivative y
Scale Factor	Optional scale factor for the computed derivative values;
Delta Offset	Optional delta value that is added to the results
Laplacian Aperture Size	Aperture size used to compute the second-derivative filters

Figure 9: Laplacian Operator

12 Sharpen

In "Sharpen" tab, you can perform sharpening on images. Behind the code, gaussian blurred image is weighted with the current image. Parameters are:

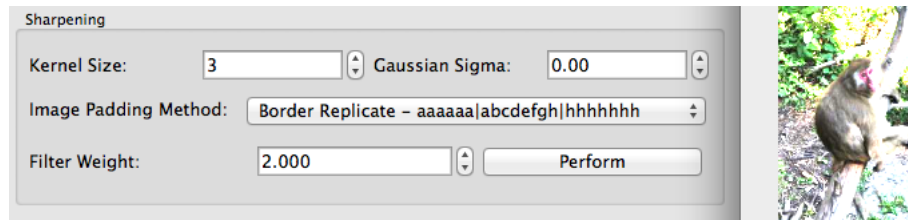| Parameters	Details
Kernel Size	Gaussian kernel size
Gaussian Sigma	Gaussian kernel standard deviation
Image Padding Method	Pixel extrapolation method
Filter Weight	Weight of the first array elements

Figure 10: Sharpening

13 Edge

In "Edge" tab, you can use Canny Edge detector algorithm to find edges in your image. There are 4 parameters for Canny. Parameters are:

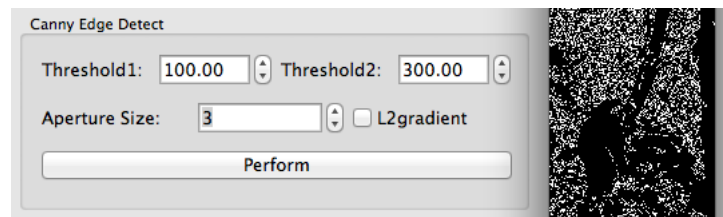| Parameters	Details
Threshold1	First threshold for the hysteresis procedure
Threshold1	Second threshold for the hysteresis procedure
Aperture Size	Aperture size for the Sobel() operator
L2gradient	Use l2 normalization should be used to calculate the image gradient magnitude

Figure 11: Canny Edge Detector

14 Hough

In "Hough" tab, you can find lines and circles with Hough Transform method. By choosing find method Lines or Circles, related parameters are enabled or disabled. Parameters are:

| Find Circle	
Parameters	**Details**
Threshold	Accumulator threshold parameter
Theta	Angle resolution of the accumulator in radians
Rho	Distance resolution of the accumulator in pixels
SRN	For the multi-scale Hough transform, it is a divisor for the distance resolution rho
STN	For the multi-scale Hough transform, it is a divisor for the distance resolution theta
Find Circle	
Parameters	**Details**
DP	Inverse ratio of the accumulator resolution to the image resolution
Min Dist	Minimum distance between the centers of the detected circles
Param1	First method-specific parameter.
Param2	Second method-specific parameter
Min Radius	Minimum circle radius
Max Radius	Maximum circle radius
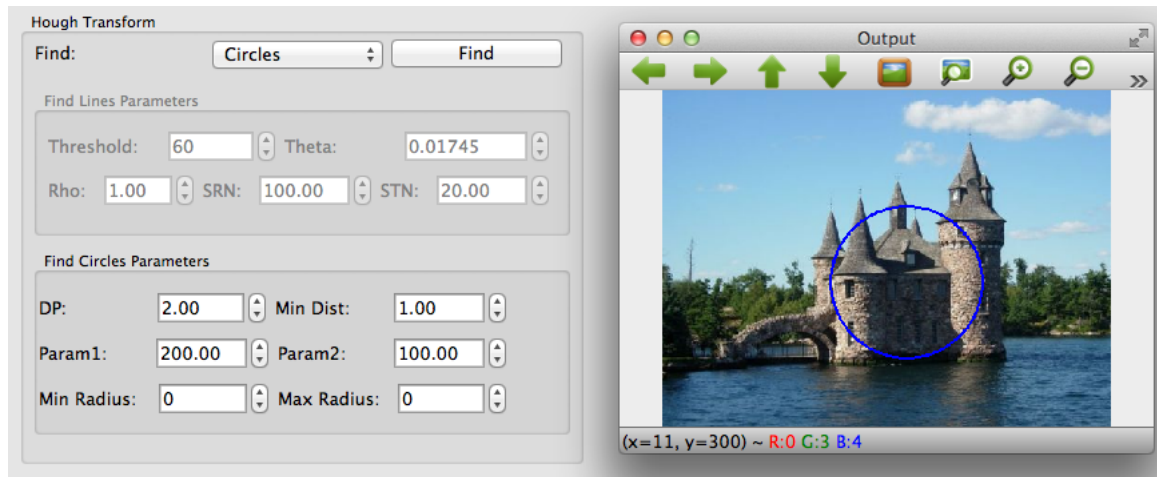
Figure 12: Hough Transform

15   Contour

In "Contour" tab, you can find contours of connected object and draw them onto image. There are many parameters available. Parameters are:

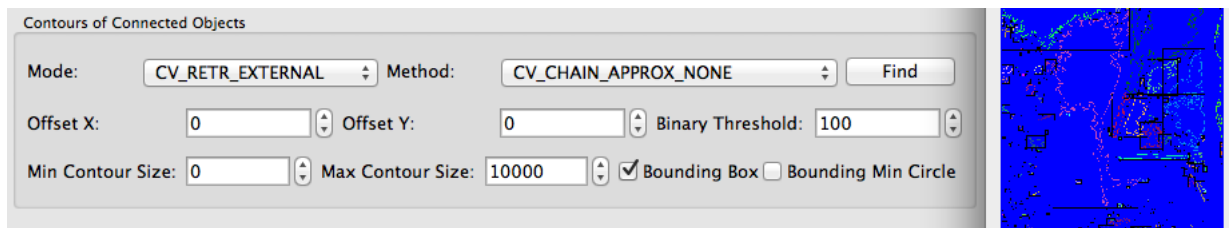| Parameters	Details
Mode	Contour retrieval mode
Method	Contour approximation method
Offset X	Optional offset by which every contour point is shifted
Offset Y	Optional offset by which every contour point is shifted
Binary Threshold	Binary threshold value before finding contour
Min Contour Size	Eliminate too short or too long contours
Max Contour Size	Eliminate too short or too long contours
Bounding Box	Drawing bounding box
Bounding Min Cirle	Drawing bounding circle

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Figure 13: Contours

16 Harris

Tn "Harris" tab, you can extract corners with Harris Corner Extraction. Parameters are:

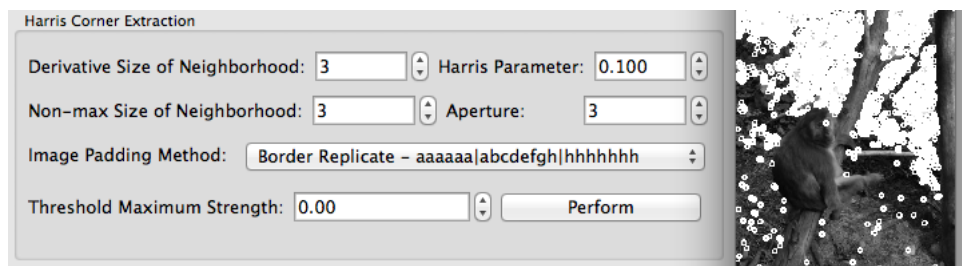| Parameters	Details
Derivative Size of Neighborhood	Neighborhood size
Harris Parameter	Harris detector free parameter
Non-max Size of Neighborhood	Aperture parameter for the Sobel() operator
Image Padding Method	Pixel extrapolation method
Threshold Max Strength	Binary threshold value before finding contour

Figure 14: Contours

17 Features

In "Features" tab you can find 3 method implemented for keypoint extraction from current image.

Figure 15: SIFT Keypoint Extraction

17.1 FAST

Using "FastFeatureDetector" and given parameters, it finds key points. Parameters are:

Parameters	Details
Threshold	Threshold on diff between intensity of the central pixel
Non-max Supression	If true, non-maximum suppression is applied to detected corners (keypoints)
Keypoint Drawing Flag	Flags setting drawing features
Keypoint Colors	Draws keypoints with different colors

17.2 SURF

Using "SurfFeatureDetector" and given parameters, it finds key points. Parameters are:

Parameters	Details
Min Hessian	Threshold on diff between intensity of central px and px of a circle around this px
Keypoint Drawing Flag	Flags setting drawing features
Keypoint Colors	Draws keypoints with different colors

17.3 SIFT

Using "SiftFeatureDetector" and given parameters, it finds key points. Parameters are:

Parameters	Details
Feature Threshold	The contrast threshold used to filter out weak features in semi-uniform regions
Edge Threshold	The threshold used to filter out edge-like features.
Keypoint Drawing Flag	Flags setting drawing features
Keypoint Colors	Draws keypoints with different colors